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## MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

### SOLUTIONS OF PROBLEMS.

16 Yale Senior Prize Problem.—Contributed by H. A. NEWTON, LL. D., Professor of Mathematics, Yale University, New Haven Connecticut.

The axes of two right cylinders whose bases are circles of 4 and 6 inches radius respectively, intersect at right angles. Compute to four decimal places the lengths of the *curves* of intersection of the two surfaces.

Solution by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

Make  $m=6$  inches, and  $n=4$  inches; then the Cartesian equations of the cylinders become  $z^2 + x^2 = m^2 \dots (1)$  and  $y^2 + x^2 = n^2 \dots (2)$ .

$$\therefore \frac{dz}{dx} = -\frac{x}{z} = -\frac{x}{\sqrt{(m^2 - x^2)}} \dots (3),$$

$$\text{and } \frac{dy}{dx} = -\frac{x}{y} = -\frac{x}{\sqrt{(n^2 - x^2)}} \dots (4).$$

Hence the expression for the *lengths* of the *curves* of intersection of the two surfaces becomes, *Todhunter's Integral Calculus*, p. 116,

$$L = 8 \int_0^n \sqrt{\left(1 + \frac{x^2}{m^2 - x^2} + \frac{x^2}{n^2 - x^2}\right)} dx \dots (5).$$

Make  $c^2 = n^2 / m^2$ , and  $x = n \sin \phi$ ; then  $dx = n \cos \phi d\phi$ . Transforming (5), etc.,

$$\begin{aligned} L &= 8 \int_0^n \sqrt{\left(\frac{m^2 n^2 - x^4}{(m^2 - x^2)(n^2 - x^2)}\right)} dx = 8n \int_0^{\frac{1}{2}\pi} \sqrt{\left(\frac{1 - c^2 \sin^4 \phi}{1 - c^2 \sin^2 \phi}\right)} d\phi \\ &= 8n \int_0^{\frac{1}{2}\pi} [1 + \frac{1}{2}c^2 \sin^2 \phi + (\frac{3}{8}c^4 - \frac{1}{2}c^2) \sin^4 \phi + (\frac{5}{8}c^6 - \frac{1}{4}c^4) \sin^6 \phi + \text{etc.}] d\phi \\ &= 4\pi n \left[ 1 + \frac{c^2}{16} + \frac{111c^4}{4016} + \text{etc.} \right] = 51.9363 + \text{inches.} \end{aligned}$$

20. Proposed by SAMUEL HART WRIGHT, M. D., M. A., Ph. D., Penn Yan, Yates County, New York

When will the Dog-Star and the Sun *rise together* in latitude  $\lambda = +42^\circ 30'$ , if the right Ascension of the said star be  $\alpha = 6h. 40m. 30s.$  and the Declination  $\delta = -16^\circ 33' 56''$ ?

Solution by F. P. MATZ, So., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.

According to *Chauvenet's Spherical and Practical Astronomy*, Vol. I.,